cervélo

S5 SUPPLEMENTARY MANUAL

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INTRODUCTION

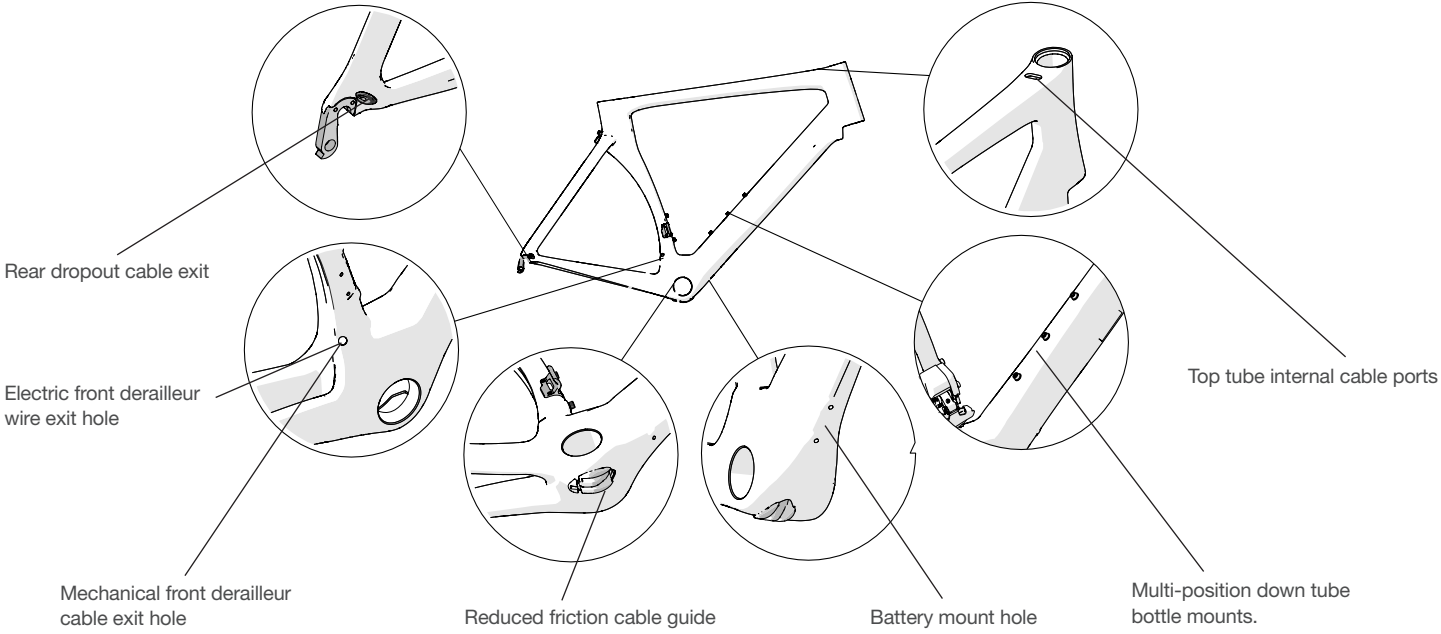
Welcome to the **Cervélo** family, and congratulations on your purchase of the fastest road bicycle ever produced.

With 20 years of aerodynamic research driving it, the S5 remains the most advanced aero-road bicycle ever developed by **Cervélo**. Engineered to exceed the performance needs of the most demanding elite riders, and designed to integrate seamlessly with the latest trends in equipment, we are proud to offer unprecedented combinations of versatility and high performance.

This document has been prepared to guide you through the set-up of the unique features of the S5, but is intended only as a supplement to the assembly instructions offered by your component manufacturer.

FEATURES DIAGRAM

A guide to your **Cervélo** S5


Rear dropout cable exit
Electric front derailleur wire exit hole
Mechanical front derailleur cable exit hole
Reduced friction cable guide
Battery mount hole
Multi-position down tube bottle mounts.
Top tube internal cable ports

GETTING STARTED

Fork

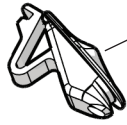
Before fitting and installing your fork, please consult the included **Cervélo** Fork Installation manual, and familiarize yourself with the correct assembly procedure. Along with the guide, you will find the **Cervélo** bond-in compression plug and sleeve, two-part epoxy, and cleaning materials. When cutting to length, **Cervélo** requires that the Steerer tube is held using the appropriate saw guide for threadless steerer, and cut using a carbon specific blade only. To ensure rider safety, the inside of the fork should be properly cleaned before the bond-in compression plug is installed, and the epoxy is allowed to cure.

Derailleur cables

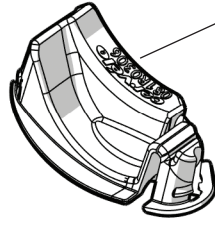
Designed to accommodate electronic, mechanical and hydraulic controls, the S5 frame has been engineered to provide seamless integration of all shifting systems, regardless of method or brand. In order to do so, you will require the parts shown on the following page:

Hydraulic hose click-in guide
(CBS-TTC-TT-HYDR)

Mechanical shifting and
brake click-in cable stops
(CBS-TTC—TT-MECH)

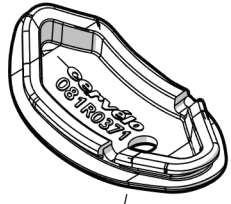


Reduced friction cable guide
(BBG-R-2013)



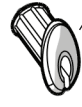
Top tube Rubber blanking
plug for battery wire hole
(GR-TTFILL-S5D)

Top tube cable stop
(ICS4-S5D)



Rubber blanking plug
for BB access port
(GR-BB-GUIDE)

Rubber electric wire
guide for rear dropout
(GR-DROPOUT-GUIDE)

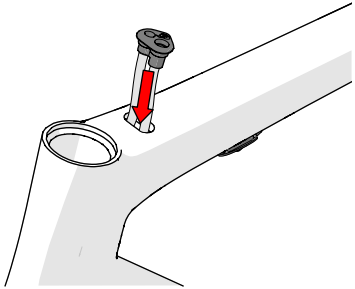


Press-In cable stop for
rear dropout
(CBS-DRPOUT)

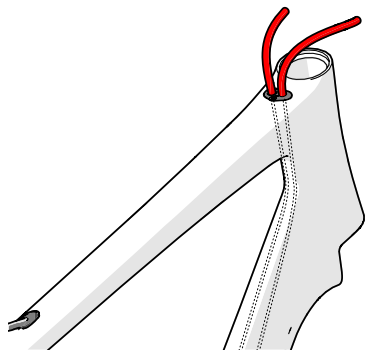
Mechanical

Front and rear derailleur cables should be assembled with the rear housing inserted into the drive-side port of the top tube cable stop, and the front housing in the non-drive side cable port (with rocket-adjuster installed). The housing should be long enough that it passed in a smooth arc from the lower back of the bar, over the stem cap, and enters the top tube cable stop perpendicular to the top tube. The housing stops in the cable stop, with the cables continuing into the frame though the plastic straws provided.

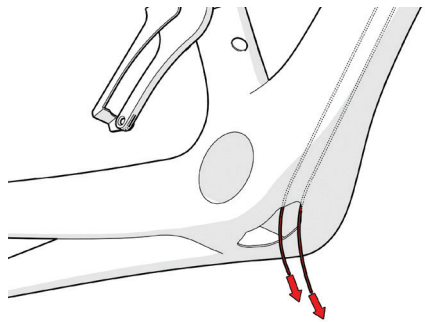
Connect the cables to derailleurs and adjust as per manufacturer's instructions



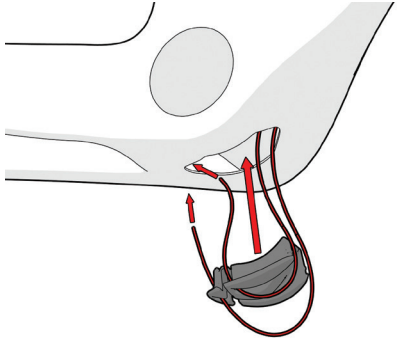
Clip in top tube cable stop



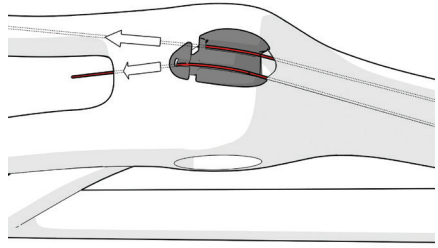
Route housings to cable stop in smooth arc



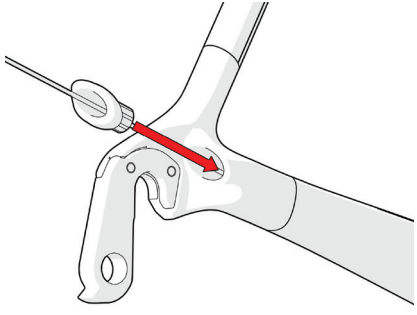
Route cables into the frame, and out of bottom bracket. Ensure cables are not twisted together.



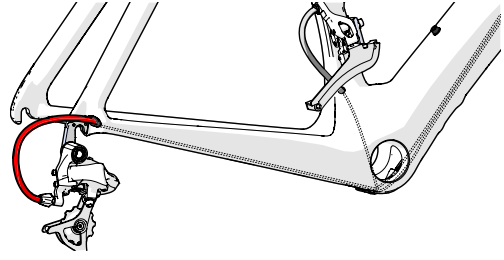
Route cables through BB guide. Front cable crosses the valley. Feed cables in direction of seat tube and chain stay.



Route cables out of front derailleur and rear dropout exit holes. Snap BB guide into frame.



Install chain stay housing stop.

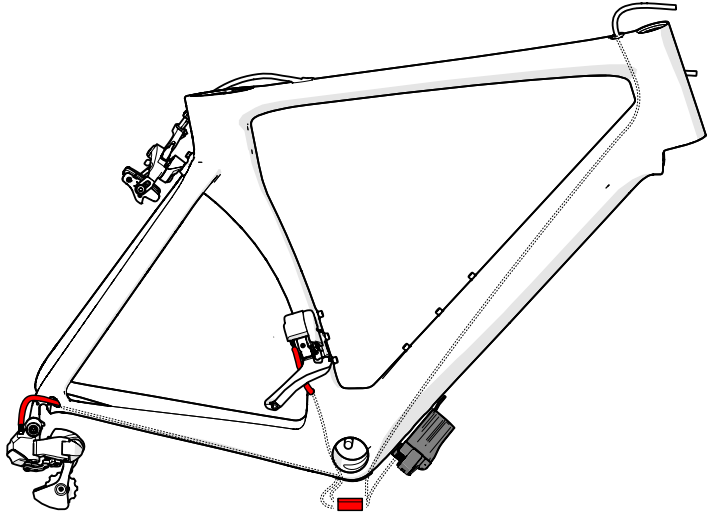


Housing stop is about 8cm farther back, so use about 8cm shorter housing than normal.

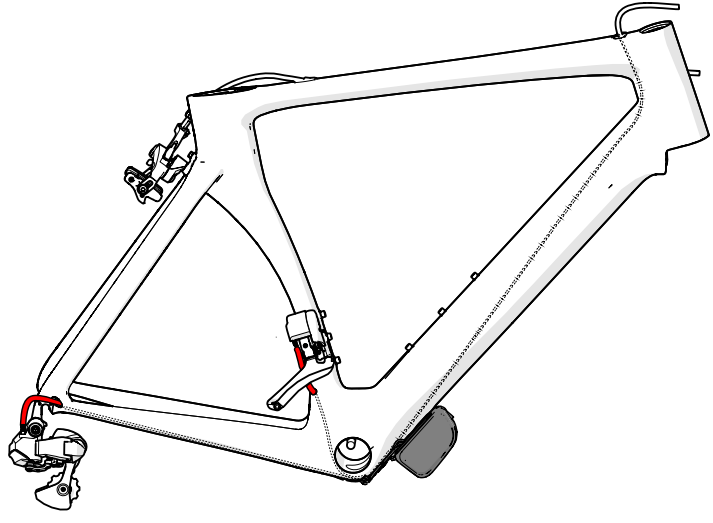
Electrical

These instructions and pictures are for assembling the Shimano and Campagnolo electronic shifting systems on the **Cervélo** S5, and are intended as a supplement to the manufacturer's installation instructions only. Please refer to www.shimano.com, www.campagnolo.com and www.cervelo.com for additional information.

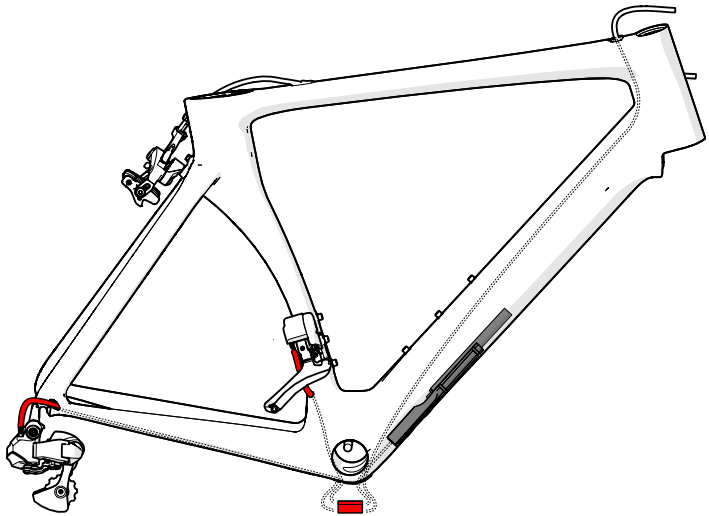
It is recommended to install the electronic system as a first step when building up a bare frame.



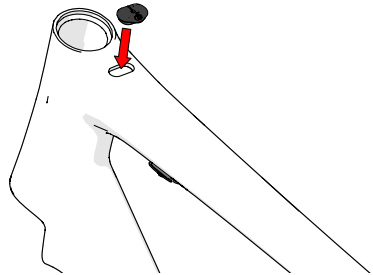
Shimano external battery

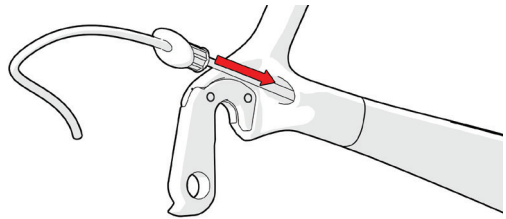


Campagnolo

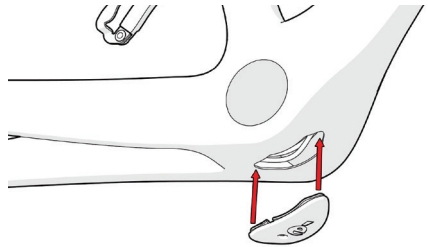


Shimano internal battery





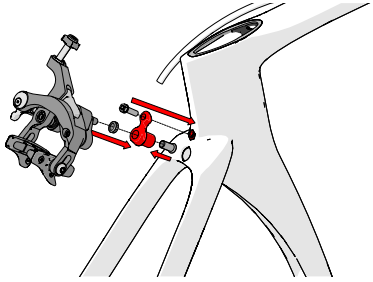
Insert rubber parts as shown.



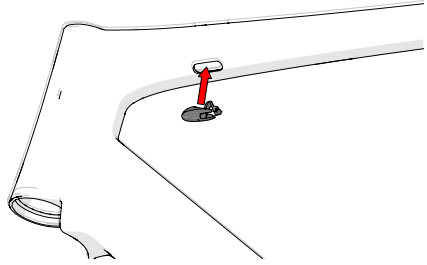
Close bottom bracket with the **Cervélo** cover.

REAR BRAKE

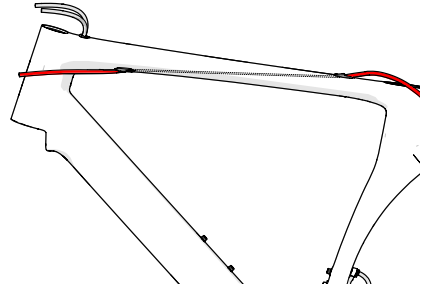
The installation of the rear brake requires the attachment of the S5 brake plate to the caliper, before it can be fitted to the frame.



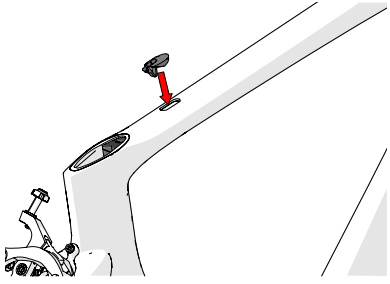
Install caliper to S5 brake plate (size specific) using 10mm fixing nut as per manufacturer's specifications. Attach S5 brake plate to frame using lightly greased M5 fixing screw. Tighten to maximum 4.5Nm.



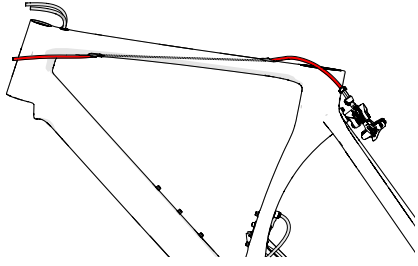
Install front click-in cable housing stop.



Route brake cable in and out of the top tube.



Install rear click-in housing stop.



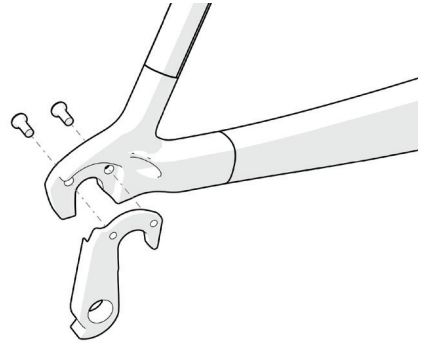
Install rear housing and adjust brake as usual.

For hydraulic brakes, substitute the appropriate click-in hose guides. Hydraulic hose guides have a 5mm through hole.

REPLACEABLE REAR DERAILLEUR MOUNT

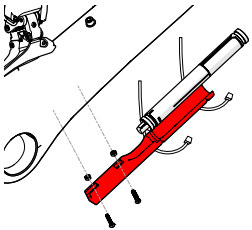
Your S5 utilizes a replaceable rear derailleur mount (DRH-R-2012) for simplified service and extended frame life. In the unfortunate event that replacement is required, **Cervélo** recommends authentic Cervélo replacement parts be used.

Inspect the frame for damage and ensure the frame is clear of any debris. Apply Loctite 242 to the fixing screws, and tighten the screws equally to a maximum of 2.5Nm. Install the wheel in the frame, and use a Derailleur Alignment Gauge to align the hanger parallel to the wheel.

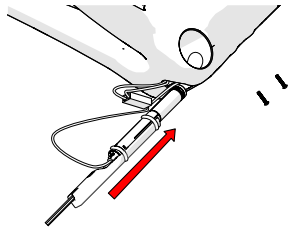


INSTALLING INTERNAL BATTERY

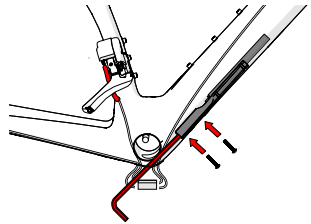
The battery for your Shimano Di2 system mounts inside the down tube using a holder (DI-BM-INT-S5D) designed to fit this frame. Because this is a sealed location, it is important to test the system and install the battery unit, prior to the bottom bracket



Attach battery to mount using 2 zip ties, and install the two M3 fixing nuts into the holder through the upper holes.



Insert a long 5mm hex key into the lower end of the battery holder to work as insertion tool. Passing the battery and holder through the opening in the bottom bracket shell, locate the battery holder so that it is inside the down tube, and the fixing nuts are positioned over the mounting holes.



Apply Loctite 242 to the M3 fixing screws, and pass them through the mounting holes so that they catch the fixing nuts in the battery holder. Tighten only slightly. Remove 5mm hex key. Using 2mm hex key, tighten fixing screws to maximum of 2.5Nm.

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OWNER'S MANUAL

For multi-speed racing bicycles

Cervélo Owner's Manual

For multi-speed racing bicycles

IMPORTANT:

This manual contains important safety, performance and service information. Read it before you take the first ride on your new bicycle, and keep it for reference.

Your Cervélo bicycle will be delivered to you fully assembled by your authorized Cervélo dealer to the requirements set out in this manual. Additional safety, performance and service information for specific components such as pedals, or for accessories such as helmets or lights that you purchase, may also be available from your dealer. Make sure that your dealer has given you all the manufacturers' literature that was included with your bicycle or accessories.

If you have any questions or do not understand something, take responsibility for your safety and consult with your dealer as a first point of contact, or with Cervélo directly.

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NOTE:
This manual is not intended as a comprehensive assembly, use, service, repair or maintenance manual. Please see your dealer for all assembly, service, repairs or maintenance. Your dealer may also be able to refer you to classes, clinics or books on bicycle use, service, repair or maintenance.

GENERAL WARNING:

Like any sport, bicycling involves risk of injury and damage. By choosing to ride a bicycle, you assume the responsibility for that risk, so you need to know — and to practice — the rules of safe and responsible riding and of proper use and maintenance. Proper use and maintenance of your bicycle reduces risk of injury.

This Manual contains many "Warnings" and "Cautions" concerning the consequences of failure to maintain or inspect your bicycle and of failure to follow safe cycling practices.

- The combination of the safety alert symbol and the word **WARNING** indicates a potentially hazardous situation which, if not avoided, could result in serious injury or death.
- The combination of the safety alert symbol and the word **CAUTION** indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or is an alert against unsafe practices.
- The word **CAUTION** used without the safety alert symbol indicates a situation which, if not avoided, could result in serious damage to the bicycle or the voiding of your warranty.

Many of the Warnings and Cautions say "you may lose control and fall". Because any fall can result in serious injury or even death, we do not always repeat the warning of possible injury or death.

Because it is impossible to anticipate every situation or condition which can occur while riding, this Manual makes no representation about the safe use of the bicycle under all conditions. There are risks associated with the use of any bicycle which cannot be predicted or avoided, and which are the sole responsibility of the rider.

A special note for parents:

As a parent or guardian, you are responsible for the activities and safety of your minor child, and that includes making sure that the bicycle is properly fitted to the child; that it is in good repair and safe operating condition; that you and your child have learned and understand the safe operation of the bicycle; and that you and your child have learned, understand and obey not only the applicable local motor vehicle, bicycle and traffic laws, but also the common sense rules of safe and responsible bicycling. *As a parent, you should read this manual, as well as review its warnings and the bicycle's functions and operating procedures with your child, before letting your child ride the bicycle.*

⚠ **WARNING: Make sure that your child always wears an approved bicycle helmet when riding; but also make sure that your child understands that a bicycle helmet is for bicycling only, and must be removed when not riding. A helmet must not be worn while playing, in play areas, on playground equipment, while climbing trees, or at any time while not riding a bicycle. Failure to follow this warning could result in serious injury or death.**

1. FIRST

NOTE: We strongly urge you to read this Manual in its entirety before your first ride. At the very least, read and make sure that you understand each point in this section, and refer to the cited sections on any issue which you don't completely understand. Please note that not all bicycles have all of the features described in this Manual. Ask your dealer to point out the features of your bicycle.

A. Bike Fit

1. Is your bike the right size? To check, see Section 3.A. If your bicycle is too large or too small for you, you may lose control and fall. If your new bike is not the right size, ask your dealer to exchange it before you ride it.

2. Is the saddle at the right height? To check, see Section 3.B. If you adjust your saddle height, follow the Minimum Insertion instructions in Section 3.B.

3. Are saddle and seatpost securely clamped? A correctly tightened saddle will allow no saddle movement in any direction. See Section 3.B.

4. Are the stem and handlebars at the right height for you? If not, see Section 3.C.

5. Can you comfortably operate the brakes? If not, you may be able to adjust their angle and reach. See Section 3.D and 3.E.

6. Do you fully understand how to operate your new bicycle? If not, before your first ride, have your dealer explain any functions or features which you do not understand.

B. Safety First

fig. 1

1. Always wear an approved helmet when riding your bike, and follow the helmet manufacturer's instructions for fit, use and care. (fig. 1)

2. Do you have all the other required and recommendedsafety equipment? (See Section 2). It's your responsibility to familiarize yourself with the laws of the areas where you ride, and to comply with all applicable laws.

3. Do you know how to correctly operate your wheel quick releases? Check Section 4.B.1 to make sure. Riding with an improperly adjusted wheel quick release can cause the wheel to wobble or disengage from the bicycle, and cause serious injury or death.

4. If your bike has toeclips and straps or clipless ("step-in") pedals, make sure you know how they work (see Section 4.E). These pedals require special techniques and skills. Follow the pedal manufacturer's instructions for use, adjustment and care.

5. Do you have "toe overlap"? On smaller framed bicycles your toe or toeclip may be able to contact the front wheel when a pedal is all the way forward and the wheel is turned. Read Section 4.E. to check whether you have toeclip overlap.

C. Mechanical Safety Check

Routinely check the condition of your bicycle before every ride.

Nuts, bolts screws & other fasteners: Because manufacturers use a wide variety of fastener sizes and shapes made in a variety of materials, often differing by model and component, it is not possible for this Manual to specify correct torque (tightening force) for each specific fastener on your bicycle. We can tell you the importance of correct torque, but not the specific torque required for each fastener on your bicycle (see Section 4. G). To correctly torque a fastener, a torque wrench must be used. A professional bicycle mechanic with a torque wrench should torque the fasteners on your bicycle. If you choose to work on your own bicycle you must get correct tightening torque specifications from the bicycle or component manufacturer or from your dealer. If you need to make an adjustment at home or in the field, we urge you to exercise care, and to have the fasteners you worked on checked by your dealer as soon as possible.

⚠ **WARNING: Correct tightening force on fasteners – nuts, bolts, screws – on your bicycle is important. Too little force, and the fastener may not hold securely. Too much force, and the fastener can strip threads, stretch, deform or break. Either way, incorrect tightening force can result in component failure, which can cause you to loose control and fall.**

Make sure nothing is loose. Lift the front wheel off the ground by two or three inches, then let it bounce on the ground. Anything sound, feel or look loose? Do a visual and tactile inspection of the whole bike. Any loose parts or accessories? If so, secure them. If you're not sure, ask someone with experience to check.

Tires & Wheels: Make sure tires are correctly inflated (see Section 4.F.1). Check by putting one hand on the saddle, one on the intersection of the handlebars and stem, then bouncing your weight on the bike while looking at tire deflection. Compare what you see with how it looks when you know the tires are correctly inflated; and adjust if necessary.

Are both tires in good shape? Spin each wheel slowly and look for cuts in the tread and sidewall. Replace damaged tires before riding the bike.

Are both wheels true? Spin each wheel and check for brake clearance and side-to-side wobble. If a wheel wobbles side to side even slightly, or rubs against or hits the brake pads, take the bike to a qualified bike shop to have the wheel trued.

⚠ **CAUTION: Wheels must be true for the brakes to work effectively. Wheel truing is a skill which requires special tools and experience. Do not attempt to true a wheel unless you have the knowledge, experience and tools needed to do the job correctly.**

Are both wheel rims clean and undamaged? Make sure the rims are clean and undamaged along the braking surface, and check for excess rim wear. See Section 5.A.4.

Brakes: Check the brakes for proper operation (see Sections 4.C). Squeeze the brake levers. Are the brake quick-releases closed? All control cables/hoses are seated and securely engaged? Do the brake pads contact the wheel rim squarely and make full contact with the rim? Do the brake pads touch the wheel rim within an inch of brake lever movement? Can you apply full braking force at the levers without having them touch the handlebar? If not, your brakes

need adjustment. Do not ride the bike until the brakes are properly adjusted by a professional bicycle mechanic.

Quick Releases: Make sure the front wheel, rear wheel and seat post quick releases are properly adjusted and in the locked position. See Section 4.B.

Handlebar and saddle alignment: Make sure the saddle and handlebar stem are parallel to the bike's center line and clamped tight enough so that you can't twist them out of alignment. See Sections 3.B and 3.C.

Handlebar ends: Make sure the handlebar grips are secure and in good condition. If not, have your dealer replace them. Make sure the handlebar ends and aerobar extensions are plugged. If not, have your dealer plug them before you ride. If the handlebars have aerobar extensions, make sure they are clamped tight enough so you can't twist them.

⚠ **WARNING: Loose or damaged handlebar grips or aerobar extensions can cause you to lose control and fall. Unplugged handlebars or extensions can cut you and cause serious injury in an otherwise minor accident.**

Rear derailleur hanger: Make sure the rear derailleur hanger is straight and undamaged. If bent or broken, have your dealer replace it before you ride. See Section 5.B.

VERY IMPORTANT SAFETY NOTE: Please also read and become thoroughly familiar with the important information on the lifespan of your bicycle and its components in Appendix A.

D. Intended Use

Cervélo produces bicycles designed and built for road racing, time trailing and triathlon. They are intended to be used for long, fast types of rides on smooth surfaces such as paved roads, and are not designed for use on rough or loose, off-road surfaces. Small changes to components such as wheels or tires will not render the bicycle suitable for use in such harsh conditions. Please consult your Cervélo dealer to ensure you are properly equipped to meet your unique requirements & specific goals.

E. First Ride

When you buckle on your helmet and go for your first familiarization ride on your new bicycle, be sure to pick a controlled environment, away from cars, other cyclists, obstacles or other hazards. Ride to become familiar with the controls, features and performance of your new bike.

Familiarize yourself with the braking action of the bike (see Section 4.C). Test the brakes at slow speed, putting your weight toward the rear and and gently applying the brakes, rear brake first. Sudden or excessive application of the front brake could pitch you over the handlebars. Applying brakes too hard can lock up a wheel, which could cause you to lose control and fall. Skidding is an example of what can happen when a wheel locks up.

If your bicycle has toeclips or clipless pedals, practice getting in and out of the pedals. See paragraph B.4 above and Section 4.E.4.

Practice shifting the gears (see Section 4.D). Remember to never move the shifter while pedaling backward, nor pedal backwards immediately after having moved the shifter. This could jam the chain and cause serious damage to the bicycle.

Check out the handling and response of the bike; and check the comfort.

If you have any questions, or if you feel anything about the bike is not as it should be, consult your dealer before your next ride.

2. SAFETY

A. The Basics

⚠ **WARNING: Many countries require specific safety devices. It is your responsibility to familiarize yourself with the laws of the region where you ride and to comply with all applicable laws, including properly equipping yourself and your bike as the law requires.**

Observe all local bicycle laws and regulations. Observe regulations about bicycle lighting, reflectors, licensing of bicycles, riding on sidewalks, laws regulating bike path and trail use, helmet laws, child carrier laws, and special bicycle traffic laws. It's your responsibility to know and obey the laws.

1. Always wear a cycling helmet which meets the latest certification standards and is appropriate for the type of riding you do. Always follow the helmet manufacturer's instructions for fit, use and care of your helmet. Most serious bicycle injuries involve head injuries which might have been avoided if the rider had worn an appropriate helmet.

⚠ **WARNING: Failure to wear a helmet when riding may result in serious injury or death.**

2. Always do the Mechanical Safety Check (Section 1.C) before you get on a bike.

3. Be thoroughly familiar with the controls of your bicycle: brakes (Section 4.C.); pedals (Section 4.E.); shifting (Section 4.D.)

4. Be careful to keep body parts and other objects away from the sharp teeth of chainrings, the moving chain, the turning pedals and cranks, and the spinning wheels of your bicycle.

5. Always wear:
   - Shoes that will stay on your feet and will grip the pedals. Make sure that shoe laces cannot get into moving parts, and never ride barefoot or in sandals.
   - Bright, visible clothing that is not so loose that it can be tangled in the bicycle or snagged by objects at the side of the road or trail.
   - Protective eyewear, to protect against airborne dirt, dust and bugs — tinted when the sun is bright, clear when it's not.

6. Don't jump with your bike. Jumping a bike can be fun; but it can put huge and unpredictable stress on the bicycle and its components. Riders who insist on jumping their bikes risk serious damage, to their bicycles as well as to themselves. Before you attempt to jump or race with your bike, read and understand Section 2.E.

7. Ride at a speed appropriate for current conditions and surroundings. Increased speed means higher risk.

B. Riding Safety

1. You are sharing the road or the path with others — motorists, pedestrians and other cyclists. Respect their rights.

2. Ride defensively. Always assume that others do not see you.

3. Look ahead, and be ready to avoid:
   - Vehicles slowing or turning, entering the road or your lane ahead of you, or coming up behind you.
   - Parked car doors opening.
   - Pedestrians stepping out.
   - Children or pets playing near the road.
   - Pot holes, sewer grating, railroad tracks, expansion joints, road or sidewalk construction, debris and other obstructions that could cause you to swerve into traffic, catch your wheel or cause you to have an accident.
   - The many other hazards and distractions which can occur on a bicycle ride.
4. Ride in designated bike lanes, on designated bike paths or as close to the edge of the road as possible, in the direction of traffic flow or as directed by local governing laws.
5. Stop at stop signs and traffic lights; slow down and look both ways at street intersections. Remember that a bicycle always loses in a collision with a motor vehicle, so be prepared to yield even if you have the right of way.
6. Use approved hand signals for turning and stopping.
7. Never ride with headphones. They mask traffic sounds and emergency vehicle sirens, distract you from concentrating on what's going on around you, and their wires can tangle in the moving parts of the bicycle, causing you to lose control.
8. Never carry a passenger, unless it is a small child wearing an approved helmet and secured in a correctly mounted child carrier or a child-carrying trailer.
9. Never carry anything which obstructs your vision or your complete control of the bicycle, or which could become entangled in the moving parts of the bicycle.
10. Never hitch a ride by holding on to another vehicle.
11. Don't do stunts, wheelies or jumps. If you intend to do stunts, wheelies, jumps or go racing with your bike despite our advice not to, read Section 2.E, *Competition*, now. Think carefully about your skills before deciding to take the large risks that go with this kind of riding.
12. Don't weave through traffic or make any moves that may surprise people with whom you are sharing the road.
13. Observe and yield the right of way.
14. Never ride your bicycle while under the influence of alcohol or drugs.
15. If possible, avoid riding in bad weather, when visibility is obscured, at dawn, dusk or in the dark, or when extremely tired. Each of these conditions increases the risk of accident.
16. Always take along some kind of identification, so that people know who you are in case of an accident; and take along a couple of dollars in cash for a candy bar, a cool drink or an emergency phone call.

C. Wet Weather Riding

⚠ WARNING: Wet weather impairs traction, braking and visibility, both for the bicyclist and for other vehicles sharing the road. The risk of an accident is dramatically increased in wet conditions.

Under wet conditions, the stopping power of your brakes (as well as the brakes of other vehicles sharing the road) is dramatically reduced and your tires don't grip nearly as well. This makes it harder to control speed and easier to lose control. To make sure that you can slow down and stop safely in wet conditions, ride more slowly and apply your brakes earlier and more gradually than you would under normal, dry conditions. See also Section 4.C.

D. Night Riding

Riding a bicycle at night is many times more dangerous than riding during the day. A bicyclist is very difficult for motorists and pedestrians to see. Therefore, children should never ride at dawn, at dusk or at night. Adults who chose to accept the greatly increased risk of riding at dawn, at dusk or at night need to take extra care both riding and choosing specialized equipment which helps reduce that risk. Consult your dealer about night riding safety equipment.

⚠ WARNING: Reflectors are not a substitute for required lights. Riding at dawn, at dusk, at night or at other times of poor visibility without an adequate bicycle lighting system is dangerous and may result in serious injury or death.

Bicycle reflectors are designed to pick up and reflect car lights and street lights in a way that may help you to be seen and recognized as a moving bicyclist.

⚠ CAUTION: Check reflectors and their mounting brackets regularly to make sure that they are clean, straight, unbroken and securely mounted. Have your dealer replace damaged reflectors and straighten or tighten any that are bent or loose.

⚠ WARNING: Do not remove the installed front or rear reflectors or reflector brackets from your bicycle. They are an integral part of the bicycle's safety system.

Removing the reflectors may reduce your visibility to others using the roadway. Being struck by other vehicles may result in serious injury or death.

If you choose to ride under conditions of poor visibility, check and be sure you comply with all local laws about night riding, and take the following strongly recommended additional precautions:

- Purchase and install battery or generator powered head and tail lights which meet all regulatory requirements and provide adequate visibility.
- Wear light colored, reflective clothing and accessories, such as a reflective vest, reflective arm and leg bands, reflective stripes on your helmet, flashing lights attached to your body and/or your bicycle...any reflective device or light source that moves will help you get the attention of approaching motorists, pedestrians and other traffic.
- Make sure your clothing or anything you may be carrying on the bicycle does not obstruct a reflector or light.
- Make sure that your bicycle is equipped with correctly positioned and securely mounted reflectors.

While riding at dawn, at dusk or at night:

- Ride slowly.
- Avoid dark areas and areas of heavy or fast-moving traffic.
- Avoid road hazards.
- If possible, ride on familiar routes.

If riding in traffic:

- Be predictable. Ride so that drivers can see you and predict your movements.
- Be alert. Ride defensively and expect the unexpected.
- If you plan to ride in traffic often, ask your dealer about traffic safety classes or a good book on bicycle traffic safety.

E. Competition

By engaging in racing or aggressive riding you voluntarily assume an increased risk of injury or death.

Not all bicycles are designed for these types of riding, and those that are may not be suitable for all types of aggressive riding. Check with your dealer or the bicycle's manufacturer about the suitability of your bicycle before engaging in competition.

When riding fast down hill, you can reach speeds seen on motorcycles, and therefore face similar hazards and risks. Have your bicycle and equipment carefully inspected by a qualified mechanic and be sure it is in perfect condition. Take your bicycle to your dealer if anything breaks or bends. Do not ride your bicycle when any part is damaged. Consult with expert riders and race officials on conditions and equipment advisable at the site where you plan to ride. Wear appropriate safety gear. Ultimately, it is your responsibility to have proper equipment and to be familiar with course conditions.

⚠ WARNING: Although many catalogs, advertisements and articles about bicycling depict riders engaged in various forms of racing, this activity can be extremely dangerous, increases your risk of injury or death, and increases the severity of any injury. Remember that the action depicted is being performed by professionals with many years of training and experience. Know your limits and always wear a helmet and other appropriate safety gear. Even with state-of-the-art protective safety gear, you could be seriously injured or killed when riding downhill at speed or in competition.

⚠ CAUTION: Bicycles and bicycle parts have limitations with regard to strength and integrity, and this type of riding can increase the likelihood of exceeding those limitations.

F. Aerobars

Caution should be exercised when utilizing aerobars at all times, as these bars, while highly effective at decreasing aerodynamic drag, also decrease the bicycle's ability to steer and brake relative to standard handlebars.

Braking is made more difficult when using aerobars as your hands are positioned further from the brake levers compared to standard handlebars – in an emergency you need first sit up and move your hands back towards the base bar and out to the brake levers to begin braking. If brake levers are attached to the aerobars, you must

remember that your weight is positioned further forward than normal, with more weight on the front wheel. Caution should be exercised when braking from this position as the forward weight bias makes it more likely for you to flip over the front wheel if the front brake is applied too strongly.

Regarding handling, the bike is more difficult to steer from the aero hand position as you are steering with your elbows instead of hands, and with a narrower total width as compared to standard handlebars. This makes it more difficult to ride in a straight line, and the bike will react more strongly to bumps or other unexpected inputs. It is highly recommended that you initially practice riding in a smooth, flat area, away from traffic, until you become familiar with the handling characteristics imparted by aerobars. Once mastered, aerobars are never recommended for use when riding in a group or in heavy traffic for safety reasons.

⚠ **WARNING: Failure to confirm compatibility, properly install, operate and maintain any aerobar or related component or accessory can result in serious injury or death.**

G. Changing Components or Adding Accessories

There are many components and accessories available to enhance the comfort, performance and appearance of your bicycle. However, if you change components or add accessories, you do so at your own risk. The bicycle's manufacturer may not have tested that component or accessory for compatibility, reliability or safety on your bicycle. Before installing any component or accessory, including a different size tire, make sure that it is compatible with your bicycle by checking with your dealer. Be sure to read, understand and follow the instructions that accompany the products you purchase for your bicycle. See also Appendix A, pp. 29.

⚠ **WARNING: Failure to confirm compatibility, properly install, operate and maintain any component or accessory can result in serious injury or death.**

CAUTION: Changing the components on your bike may void the warranty. Refer to your warranty, and check with your dealer before changing the components on your bike.

H. Maximum Weight

Cervélo frames have been designed and tested to withstand very high loads, and as a result we have not traditionally assigned maximum weight restrictions for our frames. However, your bicycle is also made up of numerous individual components, all of which have their own unique weight limits. As a result, Cervélo recommends that you consult your dealer to ensure that all components selected for use on your bicycle are suitable and safe for your intended use.

3. FIT

NOTE: Correct fit is an essential element of bicycling safety, performance and comfort. Making the adjustments to your bicycle which result in correct fit for your body and riding conditions requires experience, skill and special tools. Always have your dealer make the adjustments on your bicycle; or, if you have the experience, skill and tools, have your dealer check your work before riding.

The fit suggestions below are based solely on safety concerns. They specify the absolute minimum standards to ride the bike, but by no means do they guarantee optimal performance. Much more elaborate fit requirements are necessary to ensure optimal performance. For the

additional performance fitting requirements, please consult with your dealer.

⚠ WARNING: If your bicycle does not fit properly, you may lose control and fall. If your new bike doesn't fit, ask your dealer to exchange it before you ride it.

A. Standover Height

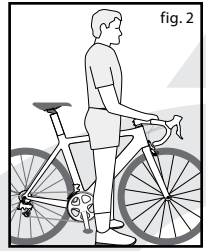


fig. 2

Standover height is the basic element of bike fit (see fig. 2). It is the distance from the ground to the top of the bicycle's frame at that point where your crotch is when straddling the bike. To check for correct standover height, straddle the bike while wearing the kind of shoes in which you'll be riding, and bounce vigorously on your heels. If your crotch touches the frame, the bike is too big for you. Don't even ride the bike around the block. A bike which you ride only on paved surfaces and never take off-road should give you a minimum standover height clearance of two inches (5 cm). A bike that you'll ride on unpaved surfaces should give you a minimum of three inches (7.5 cm) of standover height clearance. And a bike that you'll use off road should give you four inches (10 cm) or more of clearance.

⚠ WARNING: If you plan to use your bike for jumping or competition, read Section 2.E again.

B. Saddle Position

Correct saddle adjustment is an important factor in getting the most performance and comfort from your bicycle. If the saddle position is not comfortable for you, see your dealer.

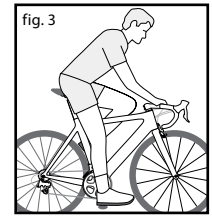


fig. 3

The saddle can be adjusted in three directions:

1. Up and down adjustment. To check for correct saddle height (fig. 3):
   - sit on the saddle;
   - place one heel on a pedal;
   - rotate the crank until the pedal with your heel on it is in the down position and the crank arm is parallel to the seat tube.

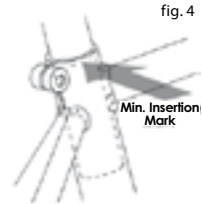


fig. 4

If your leg is not completely straight, your saddle height needs to be adjusted. If your hips must rock for the heel to reach the pedal, the saddle is too high. If your leg is bent at the knee with your heel on the pedal, the saddle is too low.

Once the saddle is at the correct height, make sure that the seatpost does not project from the frame beyond its "Minimum Insertion" mark, which means that the minimum insertion mark should never be visible above the frame once adjusted to your correct position (fig. 4). If the "Minimum Insertion" mark is visible once your saddle is properly adjusted, contact your dealer to have the seatpost replaced with a longer one.

⚠ WARNING: If your seat post projects from the frame beyond the Minimum Insertion or Maximum Extension mark (see fig.

4), the seat post may break, which could cause you to lose control and fall.

Note that some seatposts also have a second insertion mark entitled "Maximum Insertion". If present on your bicycle, your seatpost should never be lowered into the frame beyond the "Maximum Insertion" point, meaning that this line must always be visible above the frame once the saddle is properly adjusted. If the "Maximum Insertion" mark is no longer visible once your saddle is properly adjusted, contact your dealer to have the seatpost replaced with a shorter one.

⚠ **WARNING: If your seat post is inserted into the frame beyond the Maximum Insertion mark, the seat post may break, which could cause you to lose control and fall.**

Minimum saddle height is defined as the smallest possible distance between the center of the bottom bracket and the top of the saddle on a given bicycle. It can be measured along the plane of the seat tube from the top of the saddle to the center of the crank axle. Several factors can influence the minimum saddle height including thickness of the saddle, design of the seatpost clamp, seatpost length, frame size, and frame design. Cervélo does not specify the minimum saddle height on our standard geometry tables due to the variability of this dimension with component changes; instead we recommend consulting your dealer to assist in determining appropriate sizing and in fitting your bicycle to you.

2. Front and back adjustment. The saddle can be adjusted forward or back to help you get the optimal position on the bike. Ask your dealer to set the saddle for your optimal riding position and to show you how to make this adjustment.

3. Saddle angle adjustment. Most people prefer a horizontal saddle; but some riders like the saddle nose angled up or down just a little. Your dealer can adjust saddle angle or teach you how to do it.

Small changes in saddle position can have a substantial effect on performance and comfort. To find your best saddle position, make only one adjustment at a time.

⚠ **WARNING: After any saddle adjustment, be sure that the saddle adjusting mechanism is properly tightened before riding. A loose saddle clamp or seat post binder can cause damage to the seat post, or can cause you to lose control and fall. A correctly tightened saddle adjusting mechanism will allow no saddle movement in any direction. Periodically check to make sure that the saddle adjusting mechanism is properly tightened.**

If, in spite of carefully adjusting the saddle height, tilt and fore-and-aft position, your saddle is still uncomfortable, you may need a different saddle design. Saddles, like people, come in many different shapes, sizes and resilience. Your dealer can help you select a saddle which, when correctly adjusted for your body and riding style, will be comfortable.

⚠ **WARNING: Some people have claimed that extended riding with a saddle which is incorrectly adjusted or which does not support your pelvic area correctly can cause short-term or long-term injury to nerves and blood vessels, or even impotence. If your saddle causes you pain, numbness or other discomfort, listen to your body and stop riding until you see your dealer about**

saddle adjustment or a different saddle.

C. Handlebar Height and Angle

Your bike is equipped with a "threadless" stem, which clamps on to the outside of the steerer tube. Your dealer may be able to change handlebar height by moving height adjustment spacers from below the stem to above the stem, or vice versa. Otherwise, you'll have to get a stem of different length or rise. Consult your dealer. Do not attempt to do this yourself, as it requires special knowledge.

Maximum Spacer Height

- All forks should be installed in accordance with the manufacturer's instructions.

⚠ **WARNING: Exceeding the maximum spacer height can result in damage to the fork's steerer tube, which could cause you to lose control and fall.**

⚠ **WARNING: On some bicycles, changing the stem or stem height can affect the tension of the front brake cable, locking the front brake or creating excess cable slack which can make the front brake inoperable. If the front brake pads move in towards the wheel rim or out away from the wheel rim when the stem or stem height is changed, the brakes must be correctly adjusted before you ride the bicycle.**

⚠ **WARNING: The top of the stem where fitted over the fork steerer tube must not extend more than 5 mm above the top of the steerer. If the stem is extended beyond this height the stem may break or damage the fork's steerer tube, which could cause you to lose control and fall.**

Your dealer may also be able to change the angle of the handlebar or aerobar extensions.

⚠ **WARNING: An insufficiently tightened stem binder bolt, handlebar binder bolt or aerobar extension clamping bolt may compromise steering action, which could cause you to lose control and fall. Place the front wheel of the bicycle between your legs and attempt to twist the handlebar/stem assembly. If you can twist the stem in relation to the front wheel, turn the handlebars in relation to the stem, or turn the aerobar extensions in relation to the handlebar, the bolts are insufficiently tightened.**

D. Control Position Adjustments

The angle of the brake and shift control levers and their position on the handlebars can be changed. Ask your dealer to make the adjustments for you.

E. Brake Reach

Many bikes have brake levers which can be adjusted for reach. If you have small hands or find it difficult to squeeze the brake levers, your dealer can either adjust the reach or fit shorter reach brake levers.

⚠ **WARNING: The shorter the brake lever reach, the more critical it is to have correctly adjusted brakes, so that full braking power can be applied within available brake lever travel. Brake lever travel insufficient to apply full braking power can result in loss of control, which may result in serious injury or death.**

4. TECHNICAL

It's important to your safety, performance and enjoyment to understand how things work on your bicycle. We urge you to ask your dealer how to do the things described in this section before you attempt them yourself, and that you have your dealer check your work before you ride the bike. If you have even the slightest doubt as to whether you understand something in this section of the Manual, talk to your dealer. See also Appendix A, pp. 29.

A. Initial Assembly

Cervélo bicycles are shipped from the factory to the dealer only partially assembled. Your dealer will complete the assembly of the bicycle, and perform any adjustments required to make it fit you. It is strongly recommended that you allow your dealer to perform the assembly and fitting operations, as it requires specific knowledge of each part, appropriate tools, and understanding of the interactions of various materials. Your bicycle is a high performance machine, much like a racing car, and as such requires skilled maintenance in order to function safely and effectively.

Your dealer will perform the following assembly operations before your bicycle is delivered to you:

1. Fork cut to appropriate length.
2. Headset & stem installed and adjusted.
3. Handlebars clamped into stem.
4. Brake/shift levers installed onto handlebars.
5. Front brake installed on fork.
6. Brake and shifter cables threaded & attached.
7. Brakes and derailleurs adjusted.
8. Handlebars wrapped with bar tape & plugged.
9. Seat and seatpost installed.
10. Wheels installed.
11. Pedals (of your choice) installed.

If you choose to perform any assembly operations yourself, ensure that all operations are done in accordance with the specific assembly instructions published by the component manufacturer. These assembly instructions are included in the bike box provided to your dealer. Alternatively, assembly instructions are usually posted on the component manufacturer's websites, or are available from their service departments. Links to commonly-referenced component assembly instructions (by brand) are provided below. Please ensure that you locate and follow the directions for your particular component model.

- Cervélo Torque Specifications: Section G. Tightening of Fasteners
- FSA: http://fullspeedahead.com/fly.aspx?layout=tech&taxid=74
- Shimano: http://techdocs.shimano.com/techdocs/index.jsp
- SRAM: http://willyoumaketheleap.com/ - Service section

B. Wheels

1. Wheel Quick Release

⚠ **WARNING: Riding with an improperly adjusted wheel quick release can allow the wheel to wobble or fall off the bicycle,**

which can cause serious injury or death. Therefore, it is essential that you:

1. **Ask your dealer to help you make sure you know how to install and remove your wheels safely.**
2. **Understand and apply the correct technique for clamping your wheel in place with a quick release.**
3. **Each time, before you ride the bike, check that the wheel is securely clamped.**

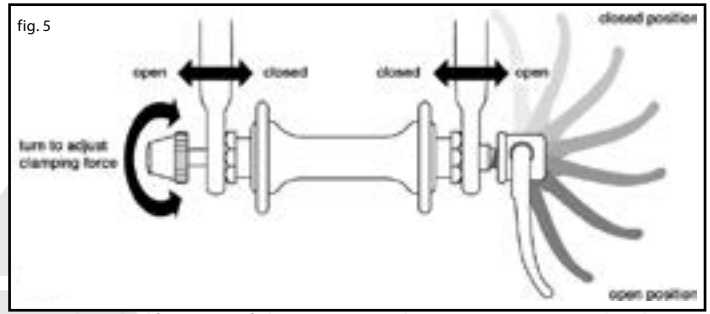
The wheel quick release uses a cam action to clamp the bike's wheel in place (see fig. 5). Because of its adjustable nature, it is critical that you understand how it works, how to use it properly, and how much force you need to apply to secure the wheel.

⚠ **WARNING: The full force of the cam action is needed to clamp the wheel securely. Holding the nut with one hand and turning the lever like a wing nut with the other hand until everything is as tight as you can get it will not clamp the wheel safely in the dropouts.**

a. Adjusting the Quick Release Mechanism

The wheel hub is clamped in place by the force of the quick release cam pushing against one dropout and pulling the tension adjusting nut, by way of the skewer, against the other dropout. The amount of clamping force is controlled by the tension adjusting nut. Turning the tension adjusting nut clockwise while keeping the cam lever from rotating increases clamping force; turning it counterclockwise while keeping the cam lever from rotating reduces clamping force.

fig. 5



Less than half a turn of the tension adjusting nut can make the difference between safe clamping force and unsafe clamping force.

b. Front Wheel Secondary Retention Devices

Most bicycles have front forks which utilize a secondary wheel retention device to reduce the risk of the wheel disengaging from the fork if the quick release is incorrectly adjusted. Secondary retention devices are not a substitute for correct quick release adjustment.

Secondary retention devices fall into two basic categories:

(1) The clip-on type is a part which the manufacturer adds to the front wheel hub or front fork.

(2) The integral type is molded, cast or machined into the outer faces of the front fork dropouts.

Ask your dealer to explain the particular secondary retention device on your bike.

⚠ **WARNING: Do not remove or disable the secondary retention**

device. As its name implies, it serves as a back-up for a critical adjustment. If the quick release is not adjusted correctly, the secondary retention device can reduce the risk of the wheel disengaging from the fork. Removing or disabling the secondary retention device may also void the warranty.

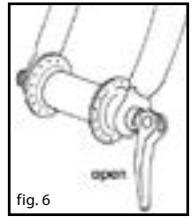


fig. 6

Secondary retention devices are not a substitute for correct quick release adjustment. Failure to properly adjust the quick release mechanism can cause the wheel to wobble or disengage, disengage, which could cause you to loose control and fall, resulting in serious injury or death.

2. Removing and Installing Quick Release Wheels

a. Removing a Quick Release Front Wheel

(1) If your bike has rim brakes, disengage the brake's quick-release mechanism to increase the clearance between the tire and the brake pads (See Section 4.C fig. 8 and 9).

(2) Move the wheel's quick-release lever from the locked or CLOSED position to the OPEN position (fig. 6). Quick release levers should be embossed with the words "OPEN" and "CLOSED" to indicate the current position of the lever.

(3) If your front fork does not have a secondary retention device go to step (5).

(4) If your front fork has a clip-on type secondary retention device, disengage it and go to step (5). If your front fork has an integral secondary retention device, loosen the tension adjusting nut enough to allow removing the wheel; then go to the next step.

(5) Raise the front wheel a few inches off the ground and tap the top of the wheel with the palm of your hand to release the wheel from the front fork.

b. Installing a Quick Release Front Wheel

(1) Move the quick-release lever so that it curves away from the wheel (fig. 6). This is the OPEN position.

(2) With the steering fork facing forward, insert the wheel between the fork blades so that the axle seats firmly at the top of the slots which are at the tips of the fork blades — the fork dropouts. The quick-release lever should be on the left side of the bicycle. If your bike has a clip-on type secondary retention device, engage it.

(3) Holding the quick-release lever in the OPEN position with your right hand, tighten the tension adjusting nut with your left hand until it is finger tight against the fork dropout (fig. 6).

(4) While pushing the wheel firmly to the top of the slots in the fork dropouts, and at the same time centering the wheel rim in the fork, move the quick-release lever upwards and swing it into the CLOSED position (fig. 5). The lever should now be parallel to the fork blade and curved toward the wheel. To apply enough clamping force, you should have to wrap your fingers around the fork blade for leverage, and the lever should leave a clear imprint in the palm of your hand.

⚠ WARNING: Securely clamping the wheel takes considerable

force. If you can fully close the quick release without wrapping your fingers around the fork blade for leverage, and the lever does not leave a clear imprint in the palm of your hand, the tension is insufficient. Open the lever; turn the tension adjusting nut clockwise a quarter turn; then try again.

(5) If the lever cannot be pushed all the way to a position parallel to the fork blade, return the lever to the OPEN position. Then turn the tension adjusting nut counterclockwise one-quarter turn and try tightening the lever again.

(6) Re-engage the brake quick-release mechanism to restore correct brake pad-to-rim clearance; spin the wheel to make sure that it is centered in the frame and clears the brake pads; then squeeze the brake lever and make sure that the brakes are operating correctly.

c. Removing a Quick Release Rear Wheel

(1) Shift the rear derailleur to high gear (the smallest, outermost rear sprocket).

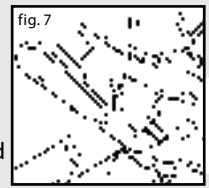


fig. 7

(2) If your bike has rim brakes, disengage the brake's quick-release mechanism to increase the clearance between the wheel rim and the brake pads (see Section 4.C, fig. 8 and 9).

(3) Pull the derailleur body back with your right hand.

(4) Move the quick-release lever to the OPEN position (fig. 6).

(5) Lift the rear wheel off the ground a few inches and, with the derailleur still pulled back, push the wheel forward and down until it comes out of the rear dropouts.

d. Installing a Quick Release Rear Wheel

(1) Make sure that the rear derailleur is still in its outermost, high gear, position

(2) Pull the derailleur body back with your right hand.

(3) Move the quick-release lever to the OPEN position (see fig. 6). The lever should be on the side of the wheel opposite the derailleur and freewheel sprockets.

(4) Put the chain on top of the smallest freewheel sprocket. Then, insert the wheel up and back into the frame dropouts and pull it all the way in to the dropouts.

(5) Tighten the quick-release adjusting nut until it is finger tight against the frame dropout; then swing the lever toward the front of the bike until it is parallel to the frame's chainstay or seatstay and is curved toward the wheel (fig. 7). To apply enough clamping force, you should have to wrap your fingers around a frame tube for leverage, and the lever should leave a clear imprint in the palm of your hand.

⚠ **WARNING: Securely clamping the wheel takes considerable force. If you can fully close the quick release without wrapping your fingers around the seatstay or chainstay for leverage, and the lever does not leave a clear imprint in the palm of your hand, the tension is insufficient. Open the lever; turn the tension adjusting nut clockwise a quarter turn; then try again.**

The rear wheel must be secured to the bicycle frame with sufficient force so that it cannot be pulled forward by the chain, even under the greatest pedaling force. If the wheel moves under pedaling force, the tire can touch the frame, which can cause you to loose control and fall.

(6) If the lever cannot be pushed all the way to a position parallel to the chainstay or seatstay tube, return the lever to the OPEN position. Then turn the adjusting nut counterclockwise one-quarter turn and try tightening again.

(7) Push the rear derailleur back into position.

(8) Re-engage the brake quick-release mechanism to restore correct brake pad-to-rim clearance; spin the wheel to make sure that it is centered in the frame and clears the brake pads; then squeeze the brake lever and make sure that the brakes are operating correctly.

C. Brakes

⚠ WARNING:

fig. 8

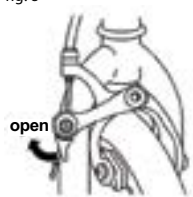
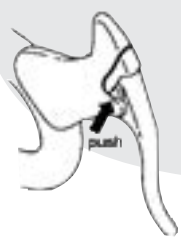


fig. 9



1. Riding with improperly adjusted brakes or worn brake pads is dangerous and can result in serious injury or death.

2. Applying brakes too hard or too suddenly can lock up a wheel, which could cause you to lose control and fall. Sudden or excessive application of the front brake may pitch the rider over the handlebars, which may result in serious injury or death.

3. See the brake manufacturer's instructions for operation and care of your brakes. If you do not have the manufacturer's instructions, see your dealer or contact the brake manufacturer.

1. Brake Controls and Features

It's very important to your safety that you learn and remember which brake lever controls which brake on your bike. Cervélo bicycles will be set up by the dealer initially so that the right hand brake lever controls the rear brake, and the left hand brake lever controls the front brake. Make sure that your hands can reach and squeeze the brake levers comfortably. If your hands are too small to operate the levers may be adjustable; or you may need a different brake lever design.

Most brakes have some form of quick-release mechanism to allow the brake pads to clear the tire when a wheel is removed or reinstalled. When the brake quick release is in the open position, the brakes are inoperative. Ask your dealer to make sure that you understand the way the brake quick release works on your bike (see figs. 8 & 9) and check each time to make sure both brakes work correctly before you get on the bike.

2. How Brakes Work

The braking action of a bicycle is a function of the friction between the brake surfaces — usually the brake pads and the wheel rim. To

make sure that you have maximum friction available, keep your wheel rims and brake pads clean and free of dirt, lubricants, waxes or polishes.

Brakes are designed to control your speed, not just to stop the bike. Maximum braking force for each wheel occurs at the point just before the wheel "locks up" (stops rotating) and starts to skid. Once the tire skids, you actually lose most of your stopping force and all directional control. You need to practice slowing and stopping smoothly without locking up a wheel. The technique is called progressive brake modulation. Instead of jerking the brake lever to the position where you think you'll generate appropriate braking force, squeeze the lever, progressively increasing the braking force. If you feel the wheel begin to lock up, release pressure just a little to keep the wheel rotating just short of lockup. It's important to develop a feel for the amount of brake lever pressure required for each wheel at different speeds and on different surfaces. To better understand this, experiment a little by walking your bike and applying different amounts of pressure to each brake lever, until the wheel locks.

When you apply one or both brakes, the bike begins to slow, but your body wants to continue at the speed at which it was going. This causes a transfer of weight to the front wheel (or, under heavy braking, around the front wheel hub, which could send you flying over the handlebars).

A wheel with more weight on it will accept greater brake pressure before lockup; a wheel with less weight will lock up with less brake pressure. So, as you apply brakes and your weight is transferred forward, you need to shift your body toward the rear of the bike, to transfer weight back on to the rear wheel; and at the same time, you need to both decrease rear braking and increase front braking force. This is even more important on descents, because descents shift weight forward.

Two keys to effective speed control and safe stopping are controlling wheel lockup and weight transfer. Practice braking and weight transfer techniques where there is no traffic or other hazards and distractions.

Everything changes when you ride on loose surfaces or in wet weather. Tire adhesion is reduced, so the wheels have less cornering and braking traction and can lock up with less brake force. Moisture or dirt on the brake pads reduces their ability to grip. The way to maintain control on loose or wet surfaces is to go more slowly to begin with.

D. Shifting Gears

Your multi-speed bicycle will have a derailleur drivetrain.

1. How a derailleur drivetrain works

The parts of the gear-changing mechanism include:

- a rear cassette or freewheel sprocket cluster
- a rear derailleur
- usually a front derailleur
- one or two shifters
- one, two or three front sprockets called chainrings
- a drive chain

a. Shifting Gears

There are several different types and styles of shifting controls: levers, twist grips, triggers, combination shift/brake controls and push-buttons. Ask your dealer to explain the type of shifting controls that are on your bike, and to show you how they work.

The vocabulary of shifting can be pretty confusing. A downshift is a shift to a "lower" or "slower" gear, one which is easier to pedal. An upshift is a shift to a "higher" or "faster", harder to pedal gear. What's confusing is that what's happening at the front derailleur is the opposite of what's happening at the rear derailleur (for details, read the instructions on Shifting the Rear Derailleur and Shifting the Front Derailleur below). For example, you can select a gear which will make pedaling easier on a hill (make a downshift) in one of two ways: shift the chain down the gear "steps" to a smaller gear at the front, or up the gear "steps" to a larger gear at the rear. So, at the rear gear cluster, what is called a downshift looks like an upshift. The way to keep things straight is to remember that shifting the chain in towards the centerline of the bike is for accelerating and climbing and is called a downshift. Moving the chain out or away from the centerline of the bike is for speed and is called an upshift.

Whether upshifting or downshifting, the bicycle derailleur system design requires that the drive chain be moving forward and be under at least some tension. A derailleur will shift only if you are pedaling forward.

⚠ **CAUTION: Never move the shifter while pedaling backward, nor pedal backwards immediately after having moved the shifter. This could jam the chain and cause serious damage to the bicycle.**

b. Shifting the Rear Derailleur

The rear derailleur is controlled by the right shifter.

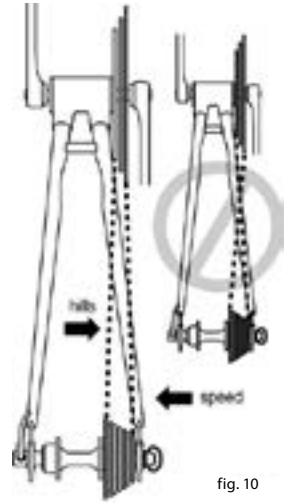


fig. 10

The function of the rear derailleur is to move the drive chain from one gear sprocket to another. The smaller sprockets on the gear cluster produce higher gear ratios. Pedaling in the higher gears requires greater pedaling effort, but takes you a greater distance with each revolution of the pedal cranks. The larger sprockets produce lower gear ratios. Using them requires less pedaling effort, but takes you a shorter distance with each pedal crank revolution. Moving the chain from a smaller sprocket of the gear cluster to a larger sprocket results in a downshift. Moving the chain from a larger sprocket to a smaller sprocket results in an upshift. In order for the derailleur to move the chain from one sprocket to another, the rider must be pedaling forward.

c. Shifting the Front Derailleur:

The front derailleur, which is controlled by the left shifter, shifts the chain between the larger and smaller chainrings. Shifting the chain onto a smaller chainring makes pedaling easier (a downshift). Shifting to a larger chainring makes pedaling harder (an upshift).

d. Which gear should I be in?

The combination of largest rear and smallest front gears (fig. 10) is for the steepest hills. The smallest rear and largest front combination is for the greatest speed. It is not necessary to shift gears in sequence. Instead, find the "starting gear" which is right for your level of ability — a gear which is hard enough for quick acceleration but easy enough to let you start from a stop without wobbling — and experiment with upshifting and downshifting to get a feel for the different gear combinations. At first, practice shifting where there are no obstacles, hazards or other traffic, until you've built up your confidence. Learn to anticipate the need to shift, and shift to a lower gear before the hill gets too steep. If you have difficulties with shifting, the problem could be mechanical adjustment.
See your dealer for help.

Cross-chain gears should be avoided at all times as these will quickly wear out the chain, and possibly also the derailleurs, chainrings, and sprockets. Cross-chain gears occur when the chain is on both the largest chainring at the front and the largest sprocket at the rear, or alternately both the smallest chainring at the front and the smallest sprocket at the rear (see fig. 10). These positions orient the chain at an angle with respect to the centerline of the bicycle, which places greater stress on the drivetrain components. There should be no need to resort to cross-chain gears as equivalent ratios can be found by using other combinations of front and rear gears.

⚠ **WARNING: Never shift a derailleur onto the largest or the smallest sprocket if the derailleur is not shifting smoothly. The derailleur may be out of adjustment and the chain could jam, causing you to lose control and fall.**

CAUTION: Never pedal for long periods in cross-chain gears as these combinations place unnecessary stress on your bicycle's drivetrain, and may result in premature wearout and decreased performance.

E. Pedals

Cervélo bicycles are not shipped with pedals, which permits the dealer and customer to select and install pedals appropriate for the intended use of the bicycle. Please consult with your dealer to ensure you have been provided all manufacturer's documentation for the installed pedals, and take responsibility to ensure that you have read and fully understand all documentation before riding any bicycle equipped with unfamiliar pedals.

1. Toe Overlap is when your toe can touch the front wheel when you turn the handlebars to steer while a pedal is in the forwardmost position. This is common on small-framed bicycles, and is avoided by keeping the inside pedal up and the outside pedal down when making sharp turns. On any bicycle, this technique will also prevent the inside pedal from striking the ground in a turn.

⚠ **WARNING: Toe Overlap could cause you to lose control and fall. Ask your dealer to help you determine if the combination of frame size, crank arm length, tire size, pedal design and shoes you will use results in pedal overlap. Note that component changes to your bicycle (cranks, tires, pedals) can result in a reduction of toe-clearance; consult your dealer about any component changes and use caution when first riding the bicycle following a component change. Whether you have overlap or not, you must keep the inside pedal up and the outside pedal down when making sharp turns.**

2. Some bicycles come equipped with pedals that have sharp and potentially dangerous surfaces. These surfaces are designed to add safety by increasing grip between the rider's shoe and the pedal. If your bicycle has this type of high-performance pedal, you must take extra care to avoid serious injury from the pedals' sharp surfaces. Based on your riding style or skill level, you may prefer a less aggressive pedal design, or chose to ride with shin pads. Your dealer can show you a number of options and make suitable recommendations.

3. Toeclips and straps are a means to keep feet correctly positioned and engaged with the pedals. The toeclip positions the ball of the foot over the pedal spindle, which gives maximum pedaling power. The toe strap, when tightened, keeps the foot engaged throughout the rotation cycle of the pedal. While toeclips and straps give some benefit with any kind of shoe, they work most effectively with cycling shoes designed for use with toeclips. Your dealer can explain how toeclips and straps work. Shoes with deep treaded soles or welts which might might make it more difficult for you to remove your foot should not be used with toeclips and straps.

⚠ **WARNING: Getting into and out of pedals with toeclips and straps requires skill which can only be acquired with practice. Until it becomes a reflex action, the technique requires concentration which can distract your attention and cause you to lose control and fall. Practice the use of toeclips and straps where there are no obstacles, hazards or traffic. Keep the straps loose, and don't tighten them until your technique and confidence in getting in and out of the pedals warrants it. Never ride in traffic with your toe straps tight.**

4. Clipless pedals (sometimes called "step-in pedals") are another means to keep feet securely in the correct position for maximum pedaling efficiency. They have a plate, called a "cleat," on the sole of the shoe, which clicks into a mating spring-loaded fixture on the pedal. They only engage or disengage with a very specific motion which must be practiced until it becomes instinctive. Clipless pedals require shoes and cleats which are compatible with the make and model pedal being used.

   Many clipless pedals are designed to allow the rider to adjust the amount of force needed to engage or disengage the foot. Follow the pedal manufacturer's instructions, or ask your dealer to show you how to make this adjustment. Use the easiest setting until engaging and disengaging becomes a reflex action, but always make sure that there is sufficient tension to prevent unintended release of your foot from the pedal.

⚠ **WARNING: Clipless pedals are intended for use with shoes specifically made to fit them and are designed to firmly keep the foot engaged with the pedal. Using shoes which do not engage the pedals correctly is dangerous.**

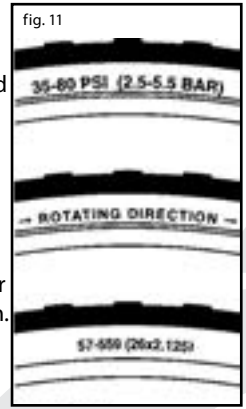
Practice is required to learn to engage and disengage the foot safely. Until engaging and disengaging the foot becomes a reflex action, the technique requires concentration which can distract your attention and cause you to lose control and fall. Practice engaging and disengaging clipless pedals in a place where there are no obstacles, hazards or traffic; and be sure to follow the pedal manufacturer's setup and service instructions. If you do not have the manufacturer's instructions, see your dealer or contact the manufacturer for advice.

F. Tires and Tubes

1. Tires

Bicycle tires are available in many designs and specifications, ranging from general-purpose designs to tires designed to perform best under very specific weather or terrain conditions. If, once you've gained experience with your new bike, you feel that a different tire might better suit your riding needs, your dealer can help you select the most appropriate design.

fig. 11



The size, pressure rating, and on some high-performance tires the specific recommended use, are marked on the sidewall of the tire (see fig. 11). The part of this information which is most important to you is Tire Pressure.

⚠ **WARNING: Never inflate a tire beyond the maximum pressure marked on the tire's sidewall. Exceeding the recommended maximum pressure may blow the tire off the rim, which could cause damage to the bike and injury to the rider and bystanders.**

The best and safest way to inflate a bicycle tire to the correct pressure is with a bicycle pump which has a built-in pressure gauge.

⚠ **WARNING: There is a safety risk in using gas station air hoses or other air compressors. They are not made for bicycle tires. They move a large volume of air very rapidly, and will raise the pressure in your tire very rapidly, which could cause the tube to explode.**

Tire pressure is given either as maximum pressure or as a pressure range. How a tire performs under different terrain or weather conditions depends largely on tire pressure. Inflating the tire to near its maximum recommended pressure gives the lowest rolling resistance; but also produces the harshest ride. High pressures work best on smooth, dry pavement.

Very low pressures, at the bottom of the recommended pressure range, give the best performance on smooth, slick terrain such as hard-packed clay, and on deep, loose surfaces such as deep, dry sand.

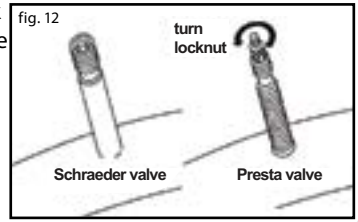
Tire pressure that is too low for your weight and the riding conditions can cause a puncture of the tube by allowing the tire to deform sufficiently to pinch the inner tube between the rim and the riding surface.

⚠ **CAUTION: Pencil type automotive tire gauges can be inaccurate and should not be relied upon for consistent, accurate pressure readings. Instead, use a high quality dial gauge.**

Ask your dealer to recommend the best tire pressure for the kind of riding you will most often do, and have the dealer inflate your tires to that pressure. Then, check inflation as described in Section 1.C so you'll know how correctly inflated tires should look and feel when you don't have access to a gauge. Some tires may need to be brought up to pressure every week or two.

Some special high-performance tires have unidirectional treads: their

tread pattern is designed to work better in one direction than in the other. The sidewall marking of a unidirectional tire will have an arrow showing the correct rotation direction. If your bike has unidirectional tires, be sure that they are mounted to rotate in the correct direction.



2. Tire Valves

There are primarily two kinds of bicycle tube valves: The Schraeder Valve and the Presta Valve. The bicycle pump you use must have the fitting appropriate to the valve stems on your bicycle.

The Schraeder valve (fig. 12) is like the valve on a car tire. To inflate a Schraeder valve tube, remove the valve cap and clamp the pump fitting onto the end of the valve stem. To let air out of a Schraeder valve, depress the pin in the end of the valve stem with the end of a key or other appropriate object.

The Presta valve (fig. 12) has a narrower diameter and is only found on bicycle tires. To inflate a Presta valve tube using a Presta headed bicycle pump, remove the valve cap; unscrew (counterclockwise) the valve stem lock nut; and push down on the valve stem to free it up. Then push the pump head on to the valve head, and inflate. To inflate a Presta valve with a Schraeder pump fitting, you'll need a Presta adapter (available at your bike shop) which screws on to the valve stem once you've freed up the valve. The adapter fits into the Schraeder pump fitting. Close the valve after inflation. To let air out of a Presta valve, open up the valve stem lock nut and depress the valve stem.

⚠ **WARNING: Patching a tube is an emergency repair. If you do not apply the patch correctly or apply several patches, the tube can fail, resulting in possible tube failure, which could cause you to loose control and fall. Replace a patched tube as soon as possible.**

3. Clincher and Tubular Tires

There are primarily two kinds of bicycle tires: The Clincher Tire and the Tubular Tire. Clincher tires are shaped like a "U" in cross section, with wire or Kevlar beads on the outer edge of both sides that hook onto the rim and hold the tire in place on the wheel over the inner tube. Tubular tires do not have beads – the outer edges of the tire are sewn together around the inner tube, which is then glued to the rim to hold it in place.

Your Cervélo bicycle will be equipped with clincher tires from the factory, however many riders may wish to purchase a second set of wheels utilizing tubular tires. If you install wheels with tubular tires on your bicycle, it is very important that you obtain and read all safety information about tubulars from the wheel & tire manufacturers, in particular the information on the proper technique for gluing the tires to the rim. Improperly glued tubular tires can separate from the rim causing a serious crash. It is up to the rider to take responsibility for ensuring their tubular wheels and tires are safe to use.

⚠ **WARNING: Improperly installed tubular tires can separate from the rims during a ride, possibly causing a serious crash that may result in injury or death.**

G. Tightening of Fasteners

Your Cervélo bicycle is equipped with precision components which require precise adjustment and care in order to function properly. Whenever components are changed or adjusted on the bicycle, it is critical for safety and performance reasons that all fasteners be tightened in accordance with the listed values below. It is recommended that you permit your dealer to perform the following adjustments, as they have the proper tools and experience to ensure it is done correctly. Improper adjustments can result in safety hazards – ensure you read all applicable documentation and have the correct tools prior to attempting any adjustments yourself.

Note that prior to assembling and tightening any bolts, all threads must be generously greased with a quality, non-lithium type grease. Torque wrenches with scale appropriate for the particular torque setting are strongly recommended for tightening all threaded fasteners.

Cervélo strongly recommends the use of carbon assembly compound/friction paste for all areas of clamping to carbon fiber, such as the seatpost to frame, the stem to fork, and the handlebar to stem joints. Benefits to using this paste include reduced corrosion potential, and a decrease in required clamping force needed to support a given load. The paste should be evenly spread on the carbon surface under the clamped area, and the applicable bolt tightened as per the following recommendations.

⚠ **WARNING: In case of a disagreement or a conflict between the following list and any supplier literature on recommended torque values for original equipment components, please contact Cervélo Customer Service for review and clarification of the required torque prior to installation.**

- Water bottle cage bolts – 2 to 3 Nm
- Stem (to handlebar/basebar) – 8 to 12 Nm for aluminum handlebars; 5Nm for carbon handlebars
- Stem (to fork steerer tube) – 4 to 5 Nm
- Bottom bracket cable guide – 1 Nm
- Brake/shift levers – 5 to 8 Nm
- Brake calipers – 8 to 10 Nm
- Brake plate (P2,P3, S5) – 4 Nm
- Rear derailleur hanger bolts – 1 Nm
- Stem top cap – Apply only enough torque to remove all headset play while ensuring it rotates freely. 1 to 2 Nm is recommended.
- Aerobar extensions (to basebar) - refer to manufacterer's specifications
- Aerobar extensions (to armrest bolt) - refer to manufacterer's specifications
- Saddle (seatpost head bolt):
  - Aero Tri/TT seatpost (P2, P3, P5, T4) saddle clamp bolt – 12 Nm; seatpost head to seatpost rail bolt – 6 to 7 Nm
  - Carbon Two Offset seatpost (S5) saddle clamp bolt – 12 Nm (Note that 2 Allen keys are necessary to prevent the bolt from turning while applying the proper torque; this must be verified using a torque wrench. Insufficient torque will cause the saddle to slip, possibly causing premature wear to the clamping mechanism.)
  - Carbon Single Offset seatpost (S2, S3) saddle clamp bolt - 12 Nm

- Round Road Seatposts (R3, R5, Rca) - refer to seatpost manufacturer's instructions
- Seattube collar:
  - Carbon TT seattube collar(P5) - 4 Nm
  - Wedge type seattube collar (S2, S3, S5, S5vwd, P2, P3) - 8 Nm
  - Non-round seattube collar (R3, R5, Rca) - 6 Nm

    Note that collar & bolt must be greased; aluminum seatposts greased, carbon seatposts coated in carbon assembly compound.
- Pedals – 30 to 35 Nm
- Wheels – Measured torque is not used for quick release wheels. The recommended industry practice is to close the release so that the resistance at the midpoint of the lever's travel from fully open to fully closed.

⚠ **WARNING: Under-tightening or over-tightening fasteners can result in damage to the bicycle that can lead to possible failure, which could cause you to lose control and fall, resulting in injury or death.**

5. SERVICE

⚠ **WARNING: Technological advances have made bicycles and bicycle components more complex, and the pace of innovation is increasing. It is impossible for this manual to provide all the information required to properly repair and/or maintain your bicycle. In order to help minimize the chances of an accident and possible injury, it is critical that you have any repair or maintenance which is not specifically described in this manual performed by your dealer. Equally important is that your individual maintenance requirements will be determined by everything from your riding style to geographic location. Consult your dealer for help in determining your maintenance requirements.**

⚠ **WARNING: Many bicycle service and repair tasks require special knowledge and tools. Do not begin any adjustments or service on your bicycle until you have learned from your dealer how to properly complete them. Improper adjustment or service may result in damage to the bicycle or in an accident which can cause serious injury or death.**

If you want to learn to do major service and repair work on your bike:

1. Ask your dealer for copies of the manufacturer's installation and service instructions for the components on your bike, or contact the component manufacturer.
2. Ask your dealer to recommend a book on bicycle repair.
3. Ask your dealer about the availability of bicycle repair courses in your area.

We recommend that you ask your dealer to check the quality of your work the first time you work on something and before you ride the bike, just to make sure that you did everything correctly. Since that will require the time of a mechanic, there may be a modest charge for this service.

A. Service Intervals

Some service and maintenance can and should be performed by the

owner, and require no special tools or knowledge beyond what is presented in this manual.

The following are examples of the type of service you should perform yourself. All other service, maintenance and repair should be performed in a properly equipped facility by a qualified bicycle mechanic using the correct tools and procedures specified by the manufacturer.

1. Break-in Period: Your bike will last longer and work better if you break it in before riding it hard. Control cables and wheel spokes may stretch or "seat" when a new bike is first used and may require readjustment by your dealer. Your Mechanical Safety Check (Section 1.C) will help you identify some things that need readjustment. But even if everything seems fine to you, it's best to take your bike back to the dealer for a checkup. Dealers typically suggest you bring the bike in for a 30 day checkup. Another way to judge when it's time for the first checkup is to bring the bike in after three to five hours of hard off-road use, or about 10 to 15 hours of on-road or more casual off-road use. But if you think something is wrong with the bike, take it to your dealer before riding it again.

2. Before every ride: Mechanical Safety Check (Section 1.C)

3. After every long or hard ride: if the bike has been exposed to water or grit; or at least every 100 miles: Clean the bike thoroughly and lightly oil the chain. Wipe off excess oil. Lubrication is a function of climate. Talk to your dealer about the best lubricants and the recommended lubrication frequency for your area.

4. After every long or hard ride or after every 10 to 20 hours of riding:
   • Squeeze the front brake and rock the bike forward and back. Everything feel solid? If you feel a clunk with each forward or backward movement of the bike, you probably have a loose headset. Have your dealer check it.

   • Lift the front wheel off the ground and swing it from side to side. Feel smooth? If you feel any binding or roughness in the steering, you may have a tight headset. Have your dealer check it.

   • Inspect both rims for damage. Check the spoke-holes on the rim for any cracks that may have formed due to fatigue. If cracks are found do not ride it – take the wheel to your dealer for replacement. Also inspect the brake surface for wear (relative to other surfaces). If a noticeable amount of wear has occurred do not ride it – take the wheel to your dealer for inspection and possible replacement. Ignoring these signs of wheel wear or damage can lead to failures of the rim.

   • Grab one pedal and rock it toward and away from the centerline of the bike; then do the same with the other pedal. Anything feel loose? If so, have your dealer check it.

   • Take a look at the brake pads. Starting to look worn or not hitting the wheel rim squarely? Time to have the dealer adjust or replace them.

   • Carefully check the control cables and cable housings. Any rust? Kinks? Fraying? If so, have your dealer replace them.

   • Squeeze each adjoining pair of spokes on either side of each wheel between your thumb and index finger. Do they all feel about the same? If any feel loose, have your dealer check the wheel for tension and trueness.

- Check to make sure that all parts and accessories are still secure, and tighten any which are not.

- Check the frame, particularly in the area around all tube joints; the handlebars; the stem; and the seatpost for any deep scratches, cracks or discoloration. These are signs of stress-caused fatigue and indicate that a part is at the end of its useful life and needs to be replaced. See also Appendix A.

⚠ **WARNING: Like any mechanical device, a bicycle and its components are subject to wear and stress. Different materials and mechanisms wear or fatigue from stress at different rates and have different life cycles. If a component's life cycle is exceeded, the component can suddenly and catastrophically fail, causing serious injury or death to the rider. Scratches, cracks, fraying and discoloration are signs of stress-caused fatigue and indicate that a part is at the end of its useful life and needs to be replaced. While the materials and workmanship of your bicycle or of individual components may be covered by a warranty for a specified period of time by the manufacturer, this is no guarantee that the product will last the term of the warranty. Product life is often related to the kind of riding you do and to the treatment to which you submit the bicycle. The bicycle's warranty is not meant to suggest that the bicycle cannot be broken or will last forever. It only means that the bicycle is covered subject to the terms of the warranty. Please be sure to read Appendix A, *Life expectancy of your bicycle and its components*, starting on page 28.**

5. As required: If either brake lever fails the Mechanical Safety Check (Section 1.C), don't ride the bike. Have your dealer check the brake. If the chain won't shift smoothly and quietly from gear to gear, the derailleur is out of adjustment. See your dealer.

6. Every 25 (hard off-road) to 50 (on-road) hours of riding: Take your bike to your dealer for a complete checkup.

B. If your bicycle sustains an impact:

- First, check yourself for injuries, and take care of them as best you can. Seek medical help if necessary.

- Next, check your bike for damage on the spot.

- Following any crash, take your bike to your dealer for a thorough check. See also Appendix A, Lifespan of your bike and its components for details on how to identify damaged parts.

⚠ **WARNING: A crash or other impact can put extraordinary stress on bicycle components, causing them to fatigue prematurely. Components suffering from stress fatigue can fail suddenly and catastrophically, causing loss of control, serious injury or death.**

C. Replacement Parts:

Over time due wearout of components or a desire to upgrade, it is likely that one or more components of your bicycle will need to be replaced. Please consult your dealer when choosing replacement parts – it is very important that suitable, genuine parts are selected and properly installed in order to maintain the safety and performance characteristics of your Cervélo bicycle. See also Appendix A, *Lifespan of your bike and its components*.

⚠ WARNING: Failure to select and properly install suitable, genuine replacement parts may lead to unforeseen changes in the safety and performance characteristics of your bicycle.

It is recommended that you use dealer-recommended OEM replacement parts for any components of your bicycle that require replacement. Your Cervélo was carefully designed and tested with the components provided, and changes to these parts can result in different performance characteristics.

APPENDIX A: THE LIFESPAN OF YOUR BIKE AND ITS COMPONENTS

1. Nothing Lasts Forever, Including Your Bike.

When the useful life of your bike or its components is over, continued use is hazardous.

Every bicycle and its component parts have a finite, limited useful life. The length of that life will vary with the construction and materials used in the frame and components; the maintenance and care the frame and components receive over their life; and the type and amount of use to which the frame and components are subjected. Use in competitive events, trick riding, ramp riding, jumping, aggressive riding, riding on severe terrain, riding in severe climates, riding with heavy loads, commercial activities and other types of non-standard use can dramatically shorten the life of the frame and components. Any one or a combination of these conditions may result in an unpredictable failure.

All aspects of use being identical, lightweight bicycles and their components will usually have a shorter life than heavier bicycles and their components. In selecting a lightweight bicycle or components you are making a tradeoff, favoring the higher performance that comes with lighter weight over longevity. So, If you choose lightweight, high performance equipment, be sure to have it inspected frequently.

You should have your bicycle and its components checked periodically by your dealer for indicators of stress and/or potential failure, including cracks, deformation, corrosion, paint peeling, dents, and any other indicators of potential problems, inappropriate use or abuse. These are important safety checks and very important to help prevent accidents, bodily injury to the rider and shortened product life.

⚠ WARNING: As with all mechanical components, the bicycle is subject to wear and high stresses. Different materials and components may react to wear and stress fatigue in different ways. If the design life of a component has been exceeded, it may suddenly fail, possibly causing injuries to the rider. Any form of crack, scratches or change of colouring in highly stressed areas indicate that the life of the component has been reached and it should be replaced.

2. Perspective

Today's high-performance bicycles require frequent and careful inspection and service. In this Appendix we try to explain some underlying material science basics and how they relate to your bicycle. We discuss some of the trade-offs made in designing your bicycle and what you can expect from your bicycle; and we provide important, basic guidelines on how to maintain and inspect it. We cannot teach you everything you need to know to properly inspect and service your bicycle; and that is why we repeatedly urge you to take your bicycle to your dealer for professional care and attention.

⚠ WARNING: Frequent inspection of your bike is important to your safety. Follow the Mechanical Safety Check in Section 1.C of this Manual before every ride.

Periodic, more detailed inspection of your bicycle is important. How often this more detailed inspection is needed depends upon you. You, the rider/owner, have control and knowledge of how often you use your bike, how hard you use it and where you use it. Because your dealer cannot track your use, you must take responsibility for periodically bringing your bike to your dealer for inspection and service. Your dealer will help you decide what frequency of inspection and service is appropriate for how and where you use your bike.

For your safety, understanding and communication with your dealer, we urge you to read this Appendix in its entirety. The materials used to make your bike determine how and how frequently to inspect.

Ignoring this WARNING can lead to frame, fork or other component failure, which can result in serious injury or death.

A. Understanding Metals

Steel is the traditional material for building bicycle frames. It has good characteristics, but in high performance bicycles, steel has been largely replaced by aluminum and some titanium. The main factor driving this change is interest by cycling enthusiasts in lighter bicycles.

Properties of Metals

Please understand that there is no simple statement that can be made that characterizes the use of different metals for bicycles. What is true is how the metal chosen is applied is much more important than the material alone. One must look at the way the bike is designed, tested, manufactured, supported along with the characteristics of the metal rather than seeking a simplistic answer.

Metals vary widely in their resistance to corrosion. Steel must be protected or rust will attack it. Aluminum and Titanium quickly develop an oxide film that protects the metal from further corrosion. Both are therefore quite resistant to corrosion. Aluminum is not perfectly corrosion resistant, and particular care must be used where it contacts other metals and galvanic corrosion can occur.

Metals are comparatively ductile. Ductile means bending, buckling and stretching before breaking. Generally speaking, of the common bicycle frame building materials steel is the most ductile, titanium less ductile, followed by aluminum.

Metals vary in density. Density is weight per unit of material. Steel weighs 7.8 grams/cm^3 (grams per cubic centimeter), titanium 4.5 grams/ cm^3, aluminum 2.75 grams/cm^3. Contrast these numbers with carbon fiber composite at 1.45 grams/cm^3.

Metals are subject to fatigue. With enough cycles of use, at high enough loads, metals will eventually develop cracks that lead to failure. It is very important that you read *The basics of metal fatigue* below.

Let's say you hit a curb, ditch, rock, car, another cyclist or other object. At any speed above a fast walk, your body will continue to move forward, momentum carrying you over the front of the bike. You cannot and will not stay on the bike, and what happens to the frame, fork and other

components is irrelevant to what happens to your body.

What should you expect from your metal frame? It depends on many complex factors, which is why we tell you that crashworthiness cannot be a design criteria. With that important note, we can tell you that if the impact is hard enough the fork or frame may be bent or buckled. On a steel bike, the steel fork may be severely bent and the frame undamaged. Aluminum is less ductile than steel, but you can expect the fork and frame to be bent or buckled. Hit harder and the top tube may be broken in tension and the down tube buckled. Hit harder and the top tube may be broken, the down tube buckled and broken, leaving the head tube and fork separated from the main triangle.

When a metal bike crashes, you will usually see some evidence of this ductility in bent, buckled or folded metal.

It is now common for the main frame to be made of metal and the fork of carbon fiber. See Section B, Understanding composites below. The relative ductility of metals and the lack of ductility of carbon fiber means that in a crash scenario you can expect some bending or bucking in the metal but none in the carbon. Below some load the carbon fork may be intact even though the frame is damaged. Above some load the carbon fork will be completely broken.

The Basics of Metal Fatigue

Common sense tells us that nothing that is used lasts forever. The more you use something, and the harder you use it, and the worse the conditions you use it in, the shorter its life.

Fatigue is the term used to describe accumulated damage to a part caused by repeated loading. To cause fatigue damage, the load the part receives must be great enough. A crude, often-used example is bending a paper clip back and forth (repeated loading) until it breaks. This simple definition will help you understand that fatigue has nothing to do with time or age. A bicycle in a garage does not fatigue. Fatigue happens only through use.

So what kind of "damage" are we talking about? On a microscopic level, a crack forms in a highly stressed area. As the load is repeatedly applied, the crack grows. At some point the crack becomes visible to the naked eye. Eventually it becomes so large that the part is too weak to carry the load that it could carry without the crack. At that point there can be a complete and immediate failure of the part.

One can design a part that is so strong that fatigue life is nearly infinite. This requires a lot of material and a lot of weight. Any structure that must be light and strong will have a finite fatigue life. Aircraft, race cars, motorcycles all have parts with finite fatigue lives. If you wanted a bicycle with an infinite fatigue life, it would weigh far more than any bicycle sold today. So we all make a tradeoff: the wonderful, lightweight performance we want requires that we inspect the structure.

A FEW THINGS TO THINK ABOUT:

- ONCE A CRACK STARTS IT CAN GROW AND GROW FAST.
  Think about the crack as forming a pathway to failure. This means that any crack is potentially dangerous and will only become more dangerous.

  SIMPLE RULE 1: If you find a crack, replace the part.

- CORROSION SPEEDS DAMAGE. Cracks grow more quickly when they are in a corrosive environment. Think about the corrosive solution as further weakening and extending the crack.

SIMPLE RULE 2: Clean your bike, lubricate your bike, protect your bike from salt, remove any salt as soon as you can.

- STAINS AND DISCOLORATION CAN OCCUR NEAR A CRACK. Such staining may be a warning sign that a crack exists.

SIMPLE RULE 3: Inspect and investigate any staining to see if it is associated with a crack.

- SIGNIFICANT SCRATCHES, GOUGES, DENTS OR SCORING CREATE STARTING POINTS FOR CRACKS. Think about the cut surface as a focal point for stress (in fact engineers call such areas "stress risers," areas where the stress is increased). Perhaps you have seen glass cut? Recall how the glass was scored and then broke on the scored line.

SIMPLE RULE 4: Do not scratch, gouge or score any surface. If you do, pay frequent attention to this area or replace the part.

- SOME CRACKS (particularly larger ones) MAY MAKE A CREAKING NOISE AS YOU RIDE. Think about such a noise as a serious warning signal. Note that a well-maintained bicycle will be very quiet and free of creaks and squeaks.

SIMPLE RULE 5: Investigate and find the source of any noise. It may not a be a crack, but whatever is causing the noise should be fixed promptly.

In most cases a fatigue crack is not a defect. It is a sign that the part has been worn out, a sign the part has reached the end of its useful life. When your car tires wear down to the point that the tread bars are contacting the road, those tires are not defective. Those tires are worn out and the tread bar says "time for replacement." When a metal part shows a fatigue crack, it is worn out. The crack says "time for replacement."

Fatigue Is Not A Perfectly Predictable Science

Fatigue is not a perfectly predictable science, but here are some general factors to help you and your dealer determine how often your bicycle should be inspected. The more you fit the "shorten product life" profile, the more frequent your need to inspect. The more you fit the "lengthen product life" profile, the less frequent your need to inspect.

Factors that shorten product life:

- Hard, harsh riding style
- "Hits," crashes, jumps, other "shots" to bike
- High mileage
- Higher body weight
- Stronger, more fit, more aggressive rider
- Corrosive environment (wet, salt air, winter road salt, accumulated sweat)
- Presence of abrasive mud, dirt, sand, soil in riding environment

Factors that lengthen product life:

- Smooth, fluid riding style
- No "hits," crashes, jumps, other "shots" to bike
- Low mileage
- Lower body weight
- Less aggressive rider
- Non-corrosive environment (dry, salt-free air)
- Clean riding environment

⚠ **WARNING: Do not ride a bicycle or component with any crack, bulge or dent, even a small one. Riding a cracked frame, fork or component could lead to complete failure, with risk of serious injury or death.**

B. Understanding Composites

All riders must understand a fundamental reality of composites.

Composite materials constructed of carbon fibers are strong and light, but when crashed or overloaded, carbon fibers do not bend, they break.

What Are Composites?

The term "composites" refers to the fact that a part or parts are made up of different components or materials. You've heard the term "carbon fiber bike." This really means "composite bike."

Carbon fiber composites are typically a strong, light fiber in a matrix of plastic, molded to form a shape. Carbon composites are light relative to metals. Steel weighs 7.8 grams/cm^3 (grams per cubic centimeter), titanium 4.5 grams/cm^3, aluminum 2.75 grams/cm^3. Contrast these numbers with carbon fiber composite at 1.45 grams/cm^3.

The composites with the best strength-to-weight ratios are made of carbon fiber in a matrix of epoxy plastic. The epoxy matrix bonds the carbon fibers together, transfers load to other fibers, and provides a smooth outer surface. The carbon fibers are the "skeleton" that carries the load.

Why Are Composites Used?

Unlike metals, which have uniform properties in all directions (engineers call this isotropic), carbon fibers can be placed in specific orientations to optimize the structure for particular loads. The choice of where to place the carbon fibers gives engineers a powerful tool to create strong, light bicycles. Engineers may also orient fibers to suit other goals such as comfort and vibration damping.

Carbon fiber composites are very corrosion resistant, much more so than most metals. Think about carbon fiber or fiberglass boats.

Carbon fiber materials have a very high strength-to-weight ratio.

What Are The Limits Of Composites?

Well designed "composite" or carbon fiber bicycles and components have long fatigue lives, usually better than their metal equivalents.

While fatigue life is an advantage of carbon fiber, you must still regularly inspect your carbon fiber frame, fork, or components.

Carbon fiber composites are not ductile. Once a carbon structure is overloaded, it will not bend; it will break. At and near the break, there will be rough, sharp edges and maybe delamination of carbon fiber or carbon fiber fabric layers. There will be no bending, buckling, or stretching.

If You Hit Something Or Have A Crash, What Can You Expect From Your Carbon Fiber Bike?

Let's say you hit a curb, ditch, rock, car, other cyclist or other object. At any speed above a fast walk, your body will continue to move forward, the momentum carrying you over the front of the bike. You cannot and will not stay on the bike and what happens to the frame fork and other components is irrelevant to what happens to your body.

What should you expect from your carbon frame? It depends on many complex factors, which is why we tell you that crash worthiness cannot be a design criteria. With that important note, we can tell you that if the impact is hard enough, the fork or frame may be completely broken. Note the significant difference in behavior between carbon and metal. See Section 2. A, Understanding metals in this Appendix. Even if the carbon frame was twice as strong as a metal frame, once the carbon frame is overloaded it will not bend, it will break completely.

Inspection of Composite Frame, Fork, and Components

Cracks:

Inspect for cracks, broken, or splintered areas. Any crack is serious. Do not ride any bicycle or component that has a crack of any size.

Delamination:

Delamination is serious damage. Composites are made from layers of fabric. Delamination means that the layers of fabric are no longer bonded together. Do not ride any bicycle or component that has any delamination. These are some delamination clues:

- A cloudy or white area. This kind of area looks different from the ordinary undamaged areas. Undamaged areas will look glassy, shiny, or "deep," as if one was looking into a clear liquid. Delaminated areas will look opaque and cloudy.
- Bulging or deformed shape. If delamination occurs, the surface shape may change. The surface may have a bump, a bulge, soft spot, or not be smooth and fair.
- A difference in sound when tapping the surface. If you gently tap the surface of an undamaged composite you will hear a consistent sound, usually a hard, sharp sound. If you then tap a delaminated area, you will hear a different sound, usually duller, less sharp.
- Bent or broken rear derailleur hanger. When an impact is sustained by the rear of the bike, or too much load is placed on the rear derailleur, the rear derailleur hanger is designed to absorb energy independent of the frame by breaking or bending. This protects the frame from greater potential damage than would otherwise occur. If the hanger is bent or broken it must be replaced before riding, as a deformed hanger can cause drivetrain interference with the rear wheel, potentially resulting in a crash. If damage to the derailleur hanger is discovered, carefully inspect the entire frame for cracks before riding, as this is a signal that excessive force was applied to the drivetrain area, and may have resulted in other damage to the bicycle.

Unusual Noises:

Either a crack or delamination can cause creaking noises while riding. Think about such a noise as a serious warning signal. A well maintained

bicycle will be very quiet and free of creaks and squeaks. Investigate and find the source of any noise. It may not be a crack or delamination, but whatever is causing the noise must be fixed before riding.

⚠ **WARNING: Do not ride a bicycle or component with any delamination or crack. Riding a delaminated or cracked frame, fork or other component could lead to complete failure, with risk of serious injury or death.**

C. Understanding Components

It is often necessary to remove and disassemble components in order to properly and carefully inspect them. This is a job for a professional bicycle mechanic with the special tools, skills and experience to inspect and service today's high-tech high-performance bicycles and their components.

Aftermarket "Super Light" components

Think carefully about your rider profile as outlined above. The more you fit the "shorten product life" profile, the more you must question the use of super light components. The more you fit the "lengthen product life" profile, the more likely it is that lighter components may be suitable for you. Discuss your needs and your profile very honestly with your dealer.

Take these choices seriously and understand that you are responsible for the changes.

A useful slogan to discuss with your dealer if you contemplate changing components is "Strong, Light, Cheap –pick two."

Original Equipment Components

Bicycle and component manufacturers test the fatigue life of the components that are original equipment on your bike. This means that they have met test criteria and have reasonable fatigue life. It does not mean that the original components will last forever. They won't. However, if replaced appropriately, and with careful use and maintenance, your Cervélo bicycle will provide you with many years of faithful service.

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